

## CRJ-700 Alerting Issues – Loss/degradation of GPS

### 1. Initiating Condition: Poor GPS satellite availability or geometry leading to decreased GPS signal integrity

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
<b>Visual Alerts</b>	Amber "MSG" appears on PFD	ANP>RNP	Salience is very low and frequently missed	Also is displayed for many non-urgent FMS messages and thus is frequently ignored or not recognized		When ANP<RNP
	Amber "LOW POSITION ACCURACY" message appears on FMS CDU message line	ANP>RNP		Can be replaced by another FMS message. Then to review the previous message you have to enter the FMS via the MSG page to see all messages; Once removed from CDU message line, can not be displayed again		When ANP<RNP
	If GPS APPR is not seen, goes away, or shows NO APPR, then this means that you do not have the approach RNP (0.3).	ANP>0.3	Salience is very low and the requirement to notice its disappearance significantly reduces conspicuity			
<b>Aural Alerts</b>	None					
<b>Tactile Alerts</b>	None					
<b>Visual Cues</b>	ANP value greater than RNP value on CDU legs/progress page	RNP limit for the aircraft, crew, and specific approach		This cue requires effortful scanning (including obtaining the proper FMS page and incorporating that display into the instrument scan, which is unusual); and interpretation		When ANP<RNP

## CRJ-700 Alerting Issues – Loss/degradation of GPS

1. Initiating Condition: Poor GPS satellite availability or geometry leading to decreased GPS signal integrity – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
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Aural Cues	None					
Tactile/Somatic Cues	None					

### Expected Pilot Response(s)

- Examine the FMS further to see what message(s) are being displayed
- For the GPS approaches, a white GPS APPR is required to be seen in the nav data block prior to the FAF for the approach (should come on 2NM prior). If this is not seen, goes away, or shows NO APPR, then this means that you do not have the approach RNP (0.3). Hence a missed approach.
- If unable to perform the procedure with the current required RNP, must choose another type of navigation or one with higher RNP tolerance
- Return to ground-based navigation, if any, as directed by the NNP
- During RNAV or RNAV/RNP approach, execute missed approach
- Hand fly lateral path during missed approach to within RNP limits (including RF leg) until automation can be re-engaged.

### Possible sources of confusion with regard to pilot response(s)

- Will only be shown when a RNP value is entered in the FMS

### How does pilot know condition is resolved/recovered?

- In FMS ANP will be displayed less than RNP
- "MSG" message on both the PFD and FMS CDU will extinguish

### Issues with regard to multiple concurrent non-normal conditions

- Loss of terrain clearance warning
- False terrain clearance warning
- Loss of separation from air traffic (ADS or Next-Gen navigation/surveillance)

## CRJ-700 Alerting Issues – Loss/degradation of GPS

### 2. Initiating Condition: Intentional interference or spoofing (intentional introduction of false position into the receiver) leading to decreased GPS signal integrity

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
<b>Visual Alerts</b>	Amber "CHK POS" appears on PFD	When predetermined values for the specific phase of flight are exceeded between the GPS and FMS location	Salience is very low and frequently missed	Once removed from CDU message line, can not be displayed again		When disagreement is resolved
	"GPS- FMS DISAGREE" in FMS on messages page					When disagreement is resolved
	Amber "MSG" appears on PFD	ANP>RNP	Only presented in subset of conditions in which calculated ANP>RNP			ANP<RNP
	Amber "LOW POSITION ACCURACY" message appears on FMS CDU message line	ANP>RNP	Only presented in subset of conditions in which calculated ANP>RNP			ANP<RNP
<b>Aural Alerts</b>	None					
<b>Tactile Alerts</b>	None					

## CRJ-700 Alerting Issues – Loss/degradation of GPS

2. Initiating Condition: Intentional interference or spoofing (intentional introduction of false position into the receiver) leading to decreased GPS signal integrity – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Cues	ANP value greater than RNP value on CDU legs/progress page	RNP limit for the aircraft, crew, and specific approach	Only presented in subset of conditions in which calculated ANP>RNP	This cue requires effortful scanning (including obtaining the proper FMS page and incorporating that display into the instrument scan, which is unusual); and interpretation		When ANP<RNP
Aural Cues	None					
Tactile/Somatic Cues	None					

### Expected Pilot Response(s)

- To examine FMS further to see what message(s) are being displayed in regard to which sensors are disagreeing. (e.g. GPS- FMS DISAGREE)
- Verify position using alternative means (e.g. radar, DME)
- Identify false information
- Eliminate source of false information from the position solution

## **CRJ-700 Alerting Issues – Loss/degradation of GPS**

2. Initiating Condition: Intentional interference or spoofing (intentional introduction of false position into the receiver) leading to decreased GPS signal integrity – Cont.

### **Possible sources of confusion with regard to pilot response(s)**

- Without effortful investigation it may not be clear to the pilot which of the navigation sources is/are providing the false position; also, because of the normally high accuracy of GPS pilots tend to believe its information and downplay the other sources. This is particularly the case because the FMS are programmed to heavily weight the GPS position in calculating the FMS position solution (in this case defaulting to 100 percent GPS position), because of the normal great accuracy of GPS. As a result, the FMS position may drift or shift into a false position that may appear, to the pilots, to be a malfunction of the IRS or Radio position sources.

### **How does pilot know condition is resolved/recovered?**

- "CHK POS" message and "GPS-FMS DISAGREE" message in FMS will extinguish
- Verifying position after reverting to alternative navigation

### **Issues with regard to multiple concurrent non-normal conditions**

- Loss of terrain clearance warning
- False terrain clearance warning
- Loss of separation from air traffic (ADS or Next-Gen navigation/surveillance)